

**What Is Claimed Is:**

1 1. A method of routing a plurality of demands in a network that comprises nodes  
2 interconnected by links, each demand having two end nodes, the method comprising:  
3 a) logically subdividing the network into a plurality of rings, wherein each ring is  
4 formed by two link-disjoint paths between a pair of nodes;  
5 b) to each of the demands, assigning a ring that contains both of the pertinent end  
6 nodes; and  
7 c) to each of the demands, assigning two mutually link-disjoint paths on the ring  
8 from one end node to the other, wherein one said path is a working path and the other  
9 said path is a protection path.

1 2. The method of claim 1, wherein each of the protection paths is node-disjoint  
2 from its corresponding working path.

1 3. The method of claim 1, further comprising, for at least one pair of end nodes,  
2 subdividing a total demand between said end nodes into a plurality of unit demands, and  
3 wherein the assigning of working paths and protection paths is performed on the unit  
4 demands.

1 4. The method of claim 3, wherein the network is an optical network, each link of  
2 the network comprises one or more optical fibers, and one unit of demand is equivalent to  
3 the bandwidth capacity of one wavelength channel on an optical fiber.

1 5. The method of claim 1, wherein each working path and each protection path is  
2 confined to a single ring.

1 6. The method of claim 1, wherein the network is an optical network, and the  
2 method further comprises assigning at least one wavelength channel to each working path  
3 and to each protection path, resulting in a working wavelength channel on the working  
4 path and a protection wavelength channel on the protection path.

1           7. The method of claim 6, wherein the assignment of wavelength channels is  
2 carried out such that no two demands have the same working wavelength channel or  
3 protection wavelength channel.

1           8. The method of claim 6, wherein the path and wavelength-channel assignments  
2 are carried out so as to drive down a cost function determined at least in part by the  
3 occupancy of wavelength channels on links of the network.

1           9. The method of claim 8, wherein the cost function is further determined by the  
2 occupancy of ports or optical termination units at nodes of the network.

1           10. The method of claim 8, wherein  
2 the links of the network comprise optical fibers,  
3 the cost function includes, for each link, a cost component for placing a further  
4 wavelength channel on such link; and

5           said cost component is selected to decrease as the number of already-placed  
6 wavelength channels increases, but to jump to a highest value when the number of  
7 already-placed wavelength channels reaches the full capacity of one optical fiber.

1           11. The method of claim 10, wherein the cost function further includes a cost  
2 component for placing wavelength ports at end nodes of the link, and the cost component  
3 is selected to decrease as the number of already-placed wavelength ports increases, but to  
4 jump to a highest value when the number of already-placed wavelength ports reaches the  
5 full capacity of one optical cross-connect.

1           12. The method of claim 8, wherein the path and wavelength-channel  
2 assignments are carried out such that the assignments to the respective demands jointly  
3 drive down the cost function.

1           13. The method of claim 1, wherein the network is an optical network, each link  
2 of the network comprises one or more optical fibers, and the method further comprises

3 assigning at least one wavelength channel to each working path and to each protection  
4 path.

1 14. The method of claim 1, wherein the network is an optical network, each link  
2 of the network comprises one or more optical fibers, and rings having a common link are  
3 permitted to share optical fibers on such common link.

1 15. The network of claim 1, wherein:  
2 the network is an optical network; each link of the network comprises one or more  
3 optical fibers;

4 the method further comprises assigning at least one wavelength channel to each  
5 working path and to each protection path; and

6 the assignment of wavelength channels is carried out such that on a given ring, the  
7 protection paths of two or more demands are permitted to share the same wavelength  
8 channel if the respective working paths of said demands have no common link on the  
9 given ring.

1 16. The method of claim 15, wherein:  
2 two or more rings having a common link are permitted to share optical fibers on such a  
3 common link; and  
4 each wavelength channel on such a shared optical fiber belongs exclusively to only one  
5 of the sharing rings.

1 17. The method of claim 16, wherein each optical fiber on a given link of a ring is  
2 allocated exclusively to one ring.

1 18. The method of claim 15, wherein:  
2 at least one of the demands routed in the network is a compound demand having a  
3 source node and a destination node and comprising two or more constituent demands  
4 each of which begins or ends on a node intermediate the source and destination nodes;

5 the assignment of rings to demands comprises assigning a ring to each of the  
6 constituent demands; and  
7 a working path or protection path for the compound demand is permitted to pass through  
8 links occupied by distinct rings.

1 19. The method of claim 18, wherein the subdividing of the network into rings  
2 comprises selecting a working path for each demand, and then defining a set of rings such  
3 that every link of the network that is occupied by a working path is also occupied by at  
4 least one ring.

1 20. The method of claim 19, further comprising designating to each link of the  
2 network sufficient optical working fibers to carry the demands routed on working paths  
3 through said link, and designating to each ring a sufficient number of optical protection  
4 fibers so that the number of protection fibers occupying each link is at least the number of  
5 working fibers occupying said link.

1 21. A method, comprising:  
2 detecting a failure at a node or link of a network resulting in the interruption of a  
3 routed working path for at least one demand;  
4 selecting a protection path for the interrupted demand; and  
5 re-routing the interrupted demand along the protection path; wherein:  
6 a) the network is logically subdivided into a plurality of rings, each ring formed  
7 by two link-disjoint paths between a pair of nodes;  
8 b) to each of a plurality of demands, each said demand having a pair of end  
9 nodes, there is assigned a ring that contains both of the pertinent end nodes; and  
10 c) the selection of a protection path for the interrupted demand comprises  
11 selecting a path that belongs to the same ring as the interrupted working path and is link-  
12 disjoint therefrom.

1 22. The method of claim 21, wherein the network is an optical network.

1 23. The method of claim 21, wherein the selected protection path is node-disjoint  
2 from the interrupted working path.

1 24. The method of claim 21, wherein:

2 at least one of the demands routed in the network is a compound demand having a  
3 source node and a destination node and comprising two or more constituent demands  
4 each of which begins or ends on a node intermediate the source and destination nodes;

5 for each said compound demand, a ring is assigned to each of the pertinent  
6 constituent demands;

7 the interrupted demand is a compound demand; and

8 the selected protection path belongs to the ring assigned to the constituent demand  
9 where the failure occurred.